ence paid in educational circles and in the newspapers to exploded theories as to climate and weather causation. Of all cases of adherence to the old beliefs, the abandoned camp of an earlier, cruder science, the remarkable deference paid the Gulf Stream theory of climate is particularly a case in point. This comes naturally from the failure to grasp the essential facts of the atmospheric circulation in the north temperate zone, whose unfailing west to east drift, broken up into two eddies, the cyclonic and the anticyclonic, distributes weather and conditions climate. Once grasp what this west to east drift means and the explanation of climate and weather is an open book. Though the theory still persists that the Gulf Stream alone by its own inherent warmth causes the mild climate of northwestern Europe, and though it is still referred to in a familiar off-hand manner by school teachers in teaching physical geography and by writers who ought to know better, as one refers to the existence of Saturn's rings, yet most people seem unfamiliar with the broader restatements of the problem now made by meteorologists.

By itself alone the Gulf Stream has as much effect on the climate of northwestern Europe as the fly in the fable had in carrying the stagecoach up the hill. The mild climate of northwestern Europe is due, not to the Gulf Stream, but to the prevailing eastward and northeastward drift of the circumpolar atmospheric circulation, whose aerial currents, and not the Gulf Stream, distribute the heat conserved by the whole Atlantic Ocean north of latitude 35° (roughly) over Europe. The entire surface of the Atlantic Ocean north of the region of the trade winds, or rather, north and west of the center of the great north Atlantic anticyclone, is drifted to the northeast by the prevailing aerial drift, which drift, and not the ocean currents, carries the beneficent influences of the ocean over the European islands and the shores to the east and northeast. The Gulf Stream, itself a result of wind motion, being produced by the joint action of the Atlantic anticyclones, is not distinguishable in temperature or "set" from the rest of the ocean by the time it gets east of Newfoundland, yet it has been given the credit that belongs to the whole mass of the Atlantic, so far as the latent power to effect climate is concerned, while at the same time the determining function played by the aerial currents of the great circumpolar drift is completely ignored. The same fallacy prevails as to the power of the Japan current to affect the coastal climate of northwestern North America.

Perhaps the most amusing recent instance of repetition of all the old rhetoric and all the old error about the Gulf Stream is in an article by Mr. F. T. Bullen, in the London Spectator, which, written in a high class publication and in the name of science, merits attention and correction. Mr. Bullen says:

> But who among us with the slightest smattering of physiography is there that is not assured that but for the genial warmth of this mighty sea-river our islands would revert to their condition at the Glacial Period; who is there but feels a shiver of dread pass over his scalp when he contemplates the possibility of any diversion of its life-giving waters from our shores? The bare suggestion of such a calamity is most terrifying

Now, as a mere matter of climatic fact, were the aerial drift, that is, the circulation of the atmosphere in the north temperate zone, to remain as it is today, and were by any possibility the Gulf Stream to be diverted at the Straits of Florida, no one in England would be a whit the wiser, for it is the aerial drift that has the gift of mildness in its flow. The diversion-of-the-Gulf-Stream bogey may impress those who have a "smattering of physiography," but it has no terror for him who knows that the Gulf Stream myth has nothing to rest on save the bad science of fifty years ago and its recrudescence in the present.

Naturally, wrong about the Gulf Stream, Mr. Bullen is so blind to the facts that modern meteorology has established, that, having endowed the Gulf Stream with virtues and influences that do not belong to it, he naturally does the same for the Kuroshiwo, the Japan current. He says of it: "It is, however, but a poor competitor in beneficence in comparison with our own Gulf Stream, as those who know their Japan in winter can testify." Now, the real fact about this is (and the same is true of the lack of effect of the Gulf Stream on the climate of New York) that since the aerial drift over Japan and over the eastern United States is from west to east, the mitigating effects of the ocean and of currents that lie to the east of the coast, are naturally not carried over the land but eastward over the water. Reverse the aerial current around the world, and Japan, by the mitigating influences of the Pacific Ocean, would have an eternal spring for its climate; while the Atlantic coast States, from North Carolina to Newfoundland would have the mildness of Bermuda, not, however, on account of any one ocean current that laved their shores, but because the conserved warmth of the ocean as a whole was theirs. As it is, the August hot waves, "Indian summer," the "green Christmases," the prolonged mild spells in January and February, the "anticipations of May" that often occur in March and befool the fruit trees are due not to any shifting of the Gulf Stream, but to the intrusion of the Atlantic anticyclone on our coasts. The circulation from the south, which is thus set up in connection with cyclonic areas over the lakes, or on our northern borders, while an anticyclone persists over our Southern States near the coast, is capable of the most surprising climatic effects, and at times seems actually to reverse the seasons.

## A REVIEW OF PROFESSOR VERY'S MEMOIR ON ATMOSPHERIC RADIATION.

By N. E. DORSEY, dated October 24, 1900.

As the author informs us, the experiments described in this work were undertaken at the suggestion of Professor Abbe, and their object can best be understood by quoting from a letter written by Professor Abbe to the author November 24, 1891. In this he says:

> Absorption *may be* the absolute inverse of *radiation* for gases, but I don't like to assume this as to intensity, and so I beg to know whether you and Professor Keeler can not undertake the following problem: To determine the absolute radiation in calories from a unit mass of gas at given density and temperature and at ordinary temperatures; not when burning, nor when electrified, but when simply heated.

The radiation was measured by a bolometer constructed after Professor Langley's earlier, double grating pattern. It consisted of 15 strips with a total exposed area of 19 square millimeters. The galvanometer was of the four-coil type, with a suspension system weighing 350 milligrammes, the magnets varying from 9.5 to 6 millimeters in length. The period was about twenty seconds, and the sensitiveness was one division $= 3.48 \times 10^{-9}$ ampere. As used with the bolometer one division corresponds to $5 \times 10^{-8}$ radim.

Professor Very defines a *radim* as "representing a unit quantity of heat, namely, one gram-water-degree-centigrade heat-unit, lost *as radiation* per square centimeter of surface per second of time, by a heated body, or transmitted by the ether as an equivalent amount of radiant energy through a normal section of one square centimeter in one second of time." But he actually uses as his standard of radiation the difference in the amounts of heat radiated per square centimeter per second to a hemisphere, by blackened copper at 100° C. and at 0° C., which he considers as equivalent to 0.0126 radim.

He employs three different methods for determining the radiation of the gases used, but discards the first as unreliable. The second is to have a jet of hot air of adjustable thickness rise in front of his bolometer and take the deflections with the jet on, and off. In the third the gas was contained in a metal cylinder closed at one end by a rock salt window and at the other provided with a stuffing-box, through which passed a rod carrying a blackened copper piston whose diameter was but slightly smaller than that of the interior of the cylinder. By changing the position of the piston the length of the radiating column of gas could be regulated as desired. The cylinder was heated by means of four large Bunsen burners. With this arrangement both temperature and pressure could also be varied. Convection currents were very troublesome, and the temperature as determined by the thermometer in the cylinder was uncertain, except when the apparatus had been cooling for a considerable time.

Having described in detail these various methods of work and given numerous tables of unreduced observations, he devotes some thirty pages to a discussion of some of Tyndall's experiments, and of the work done by Paschen, Angström, and others on the radiation and absorption of gases. From the work of these men he obtains certain correction terms which he applies to his observations, and in Table 73, page 112, gives his final results. In my examination of the memoir I have been unable to discover which of the 72 preceding tables contain the observations, which, when corrected by a process, also not very clear to me, will give this table. However, as he says that this gives merely "an approximate conception of the relations between total radiation" from unit surface under different conditions of temperature and depth of layer, this makes but little difference.

In conclusion he states: "The results of the present research prove that within moderate depths of only a few meters the radiation of dry air, purified from carbon dioxide, increases quite uniformly with the depth." The radiation from a layer of air one meter deep at 50° C and atmospheric pressure is 0.00068 radim, "as compared with one at 0° C," and for a similar layer of carbon dioxide it is 0.00238 radim, or about three and one-half times that of air. Further increase in depth of carbon dioxide adds but little (at this temperature) to the radiation. The radiation from a layer of steam 152 cm. deep, and at one-sixth of atmospheric pressure, is eight-tenths of that of a black body.

Considering the importance of the work it is a pity more pains were not taken to maintain the radiating gas at a uniform and constant temperature.

## MONTHLY STATEMENT OF AVERAGE WEATHER CONDITIONS FOR SEPTEMBER.[1]

By Prof. E. B. GARRIOTT.

The following statements are based on average weather conditions for September, as determined by long series of observations. As the weather for any given September does not conform strictly to the average conditions, the statements can not be considered as forecasts.

In the middle latitudes of the Northern Hemisphere the settled weather of summer begins to give way to the more pronounced weather types of autumn. In the tropical regions of the oceans September marks the height of the hurricane season.

[1] The first of this series was for August, 1900, and will be found in the MONTHLY WEATHER REVIEW for that month on page 342.

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Over the North Atlantic Ocean the great permanent high barometer area near the Azores decreases in magnitude, and the severer storms which advance from the American continent or adjacent waters pursue a more southerly course than during August. Storms of this class which cross the Atlantic from the American to the European coast average about two a month in September, and the likelihood of encountering them along the transatlantic steamship routes is greater than during the two preceding months. Fog is less frequent over and near the banks of Newfoundland than during August, and the average southern limit of Arctic ice in the North Atlantic is in about latitude north 47°.

All parts of the West Indies are subject to hurricane visitations in September. The hurricanes of this month are, however, somewhat more frequent in an area which embraces Santo Domingo, Haiti, and eastern and central Cuba, where they average about one in three years. The smaller diameter of the vortex of a hurricane renders it improbable that any locality in the area referred to will experience a hurricane oftener than about once in fifteen years. The hurricanes of September sometimes recurve north and northeast along the Atlantic coast of the United States and disappear over the Atlantic east of Newfoundland, and others pass westward over the Gulf of Mexico. The exceptionally destructive character of many of these storms should prompt all possible protective measures in the line of their probable advance as indicated by the warnings of the Weather Bureau.

The typhoons of the Philippine Islands and the China and Japan seas and coasts usually advance from the region east of the Philippine Islands, between the tenth and twentieth parallels of north latitude, move westward, their centers crossing the Philippines north of the fifteenth parallel, and, in a majority of cases, recurve north and northeast near the China coast and pass thence over or near the Japanese Islands. A small proportion of these storms move westward over the China Sea, and in rare instances typhoons appear to originate over the eastern part of the China Sea. The severe September typhoons average about one a year. Torrential rains are of almost daily occurrence in the Philippine Islands in September.

In the United States the most important storms of September advance from the West Indies and the Gulf of Mexico to the Atlantic and Gulf coasts. Storms of this class commonly possess great strength, and on an average of about once in two years they are destructive to shipping and coast industries. Over the Great Lakes gales of marked strength occur on an average about once in each September. As the month advances the rains which occur east of the Mississippi become general, rather than local, in character, and attend the passage of well-marked storms. September is a month of heavy subtropical rains in the south Atlantic and east Gulf coast districts, and a second maximum of rain occurs in the Lake region. Except in the lower Missouri Valley, on the north Pacific coast, and in areas in the Southwest, the rainfall west of the Mississippi is usually very light in September, and over great parts of the middle Plateau region and California no rain, as a rule, falls in that month. During the last half of September killing frost is likely to occur in the Northwestern States and the Lake region, and frost is not uncommon in the Ohio Valley and Tennessee toward the close of September.